ASSESSMENT AND TREATMENT OF CONTAMINATED DREDGED SEDIMENTS FROM PASSAIC RIVER

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Navigable waters including Hackensack and Passaic Rivers are dredged regularly to maintain and sometimes extend water depths. Dredged sediments are often highly contaminated and their disposal is not only expensive but also unsustainable. If effectively stabilized, dredged sediments have potential for beneficial reuse in the construction industry as an alternative to disposal. In this study, metal contaminants (Zn, Mn, Pb, Cd, Ba, and Se) in sediments from Passaic River and from Dampremy, Belgium were assessed using a suite of complementary analyses including the U.S. EPA toxicity characteristic leaching procedure (TCLP), synthetic precipitation leaching procedure (SPLP), sequential extraction, x-ray diffraction (XRD), and x-ray absorption spectroscopy (XAS). Interestingly, sediments from both locations showed similar levels of metal contaminants. For Passaic River sediments, Zn was the most abundant contaminant (1136 mg/kg) followed by Mn (476 mg/kg), Ba (296 mg/kg), Pb (118 mg/kg), Cd (30 mg/kg), and Se (< 20 mg/kg). Using linear combination and principal component analyses, XAS data showed Zn in untreated sediments was adsorbed to hydrous iron oxides (41.3%), precipitated as hydrozincite (37.9%), and adsorbed to montmorillonite (20.8%). Stabilizing of the contaminated sediments was examined using phosphate addition and thermal treatment at 700 ^{o}C to form sparingly soluble metal hydroxylapatites and mineralize organics. Leaching of the metal contaminants as determined using TCLP was reduced in the treated sediments by as much as 89%. XAS analyses of treated Dampremy sediments showed the Zn speciation as the crystalline phases: temperature induced, gahnite ($ZnAl_2O_4$) at 46.5%; phosphate mineral, hopeite ($Zn_3(PO_4)_2 \cdot 4H_2O$) at 36.2%; and $ZnSO_4$ at 17.3%. Thermodynamic analyses confirmed stability of the mineral phases in the treated sediments.